



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/AU91/00453 <b>(22) International Filing Date:</b> 3 October 1991 (03.10.91)  <b>(30) Priority data:</b> PK 2689                      9 October 1990 (09.10.90)      AU PK 3037                      26 October 1990 (26.10.90)      AU 76164/91                    29 April 1991 (29.04.91)      AU PK 3406                      16 November 1990 (16.11.90)    AU  <b>(71)(72) Applicant and Inventor:</b> ROBINSON, Donald, Scott [AU/AU]; 7 Leo Street, East Bentleigh, VIC 3165 (AU).  <b>(74) Agents:</b> HUNTSMAN, Peter, H. et al.; Davies & Collison, 1 Little Collins Street, Melbourne, VIC 3000 (AU).		<b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i> <i>With amended claims.</i>
<b>(54) Title:</b> PRESSURIZED FUEL VESSEL  <div style="text-align: center;"> </div> <b>(57) Abstract</b>  <p>A pressurized fuel vessel (10) for automotive or other use has opposed axial end walls (12, 14) connected at or adjacent an outer periphery (16) to define an enclosed chamber. The vessel (10) is of greater diametrical dimension than axial dimension, and internal reinforcing means (20, 22) extends between the opposed axial end walls (12, 14), including at least one reinforcing wall means (22) which extends at least substantially about an axis (18) of the vessel (10) intermediate the axis (18) and the outer periphery (16). The at least one reinforcing wall means (22) is adapted to permit pressurized fuel to flow between portions of the chamber respectively disposed radially inwardly and radially outwardly thereof, for example by having one or more openings (26) therethrough. The at least one reinforcing wall means (22) may be, for example, substantially annular or spiral. A spiral wall means (22) may be integral with the outer periphery (16). Methods of making the fuel vessel are also defined.</p>		

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**PRESSURIZED FUEL VESSEL**

The present invention relates to a pressurized fuel vessel which, while it is adapted for automotive use, may be used in other areas, and to methods of manufacturing same.

Conventional pressurized liquid fuel cylinders for automotive use are constructed in three pieces with two dished ends welded circumferentially to a cylindrical portion which is formed by rolling plate steel and welding the opposed edges together. Such a cylinder may occupy a substantial amount of space in the boot of a vehicle, and in some small cars there is insufficient room to fit such a cylinder of requisite size.

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It has been previously proposed to provide an automobile pressurized fuel vessel which is shaped and sized to fit into a well in the floor of the boot of the automobile which would otherwise accommodate a spare wheel for the automobile so as to reduce the volume of space in the boot occupied by the vessel. GB 2095808 discloses a toroidal vessel and NL 7703630 discloses a somewhat squashed substantially toroidal vessel in which the axis of the vessel is sealed off by a sleeve to define a toroidal chamber for the fuel.

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One of the problems of providing a fuel vessel which on the one hand is adapted to fit into the spare wheel well of an automobile and on the other hand accommodates as much fuel as possible is that it must have a generally circular cross-section and have a substantially greater

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diametrical than axial dimension. This presents considerable difficulties in providing sufficient strength in the axial end walls which are proposed to be overcome in the aforementioned patent specifications by giving the end walls a considerable degree of external convexity while also reinforcing the axis by providing the aforementioned toroidal structure. Both such strength-giving proposals tend to reduce the internal volume of the vessels.

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According to one aspect of the present invention, there is provided a pressurized fuel vessel for automotive or other use having opposed axial end walls connected at or adjacent an outer periphery to define an enclosed chamber, said vessel being of greater diametrical dimension (as herein defined) than axial dimension, and wherein internal reinforcing means extends between the opposed axial end walls, said internal reinforcing means comprising at least one reinforcing wall means which extends at least substantially about an axis of the vessel intermediate the axis and the outer periphery, said at least one reinforcing wall means being adapted to permit pressurized fuel to flow between portions of the chamber respectively disposed radially inwardly and radially outwardly thereof.

Where the pressurized fuel vessel in accordance with the invention is used in an automobile, it may advantageously be sized to fit into a spare wheel well in the boot of the automobile. As is well known, the well may be provided in the floor of the boot or, for example, in a wing of the automobile in which case the vessel would likely only be partially received in the well in an upright manner. Alternatively, the fuel vessel may be supported externally, as for example in a truck.

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The vessel preferably has a substantially circular cross-section (optionally with a segmental portion removed therefrom to allow the vessel to fit better in a well in a wing of an automobile) and the term "diametrical dimension" should be construed in relation to the smallest circle within which the vessel can be located. Thus, the cross-section may be rectangular or any other non-circular cross-section, such as ellipsoidal, if desired. The axis about which or substantially about which the at least one reinforcing wall means extends will usually be the central axis of such smallest circle, but not necessarily. Thus, reinforcing wall means could extend respectively about two or more spaced axes, each permitting fuel flow between portions of the chamber disposed respectively radially inwardly and radially outwardly thereof.

As with a spare wheel and tire combination, the diametrical dimension of the fuel vessel is preferably at least twice the axial dimension, and, for example, the respective dimensions may be 600 mm and 240 mm, but where the vessel is intended to fit in the spare wheel well the dimensions may be determined by the size of the well.

The internal reinforcing means is provided to reduce the minimum permissible thickness of the opposed axial end walls of the vessel and the at least one reinforcing wall means may be substantially annular. If a plurality of substantially annular reinforcing wall means are provided about the axis they are advantageously substantially equally radially spaced between the axis and the outer periphery. Alternatively, the reinforcing wall means may have a spiral configuration, defined by one or more spiral wall members. In a preferred embodiment at least one substantially cylindrical or spiral reinforcing wall member extends between the opposed axial end walls

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coaxial with the substantially circular outer periphery and with at least one opening through the or each substantially cylindrical wall member to permit the contents of the vessel to communicate with both sides of the wall member. The or each wall member may be foraminous or, for example, have one or a series of openings formed along one or more edges thereof, although this should not be necessary with a spiral wall member when the flow may be around the radially inner end at least. An annular reinforcing wall means may be discontinuous to provide said flow.

Most advantageously, the at least one reinforcing wall means is welded to the axially inner surface of each of said opposed axial end walls, and according to a second aspect of the present invention there is provided a method of manufacturing a fuel vessel according to the first aspect of the present invention which has an outer wall member at least partly defining the outer periphery of the vessel, which method comprises welding said at least one reinforcing wall means to opposed wall members at least partly defining the opposed axial end walls from a radially outwards location through the open outer periphery of the vessel and welding the outer wall member to said opposed wall members. A reinforcing wall means of spiral configuration may extend to the outer wall member, but in one embodiment the reinforcing wall means of spiral configuration is integral with the outer wall member and said method comprises continuing to weld said at least one reinforcing wall means of spiral configuration to said opposed wall members at said outer periphery to define said outer wall member.

The internal reinforcing means may include additional reinforcing means to said at least one reinforcing wall means, for example one or more columns which extend

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parallel to the axis of the vessel and which are welded or otherwise secured to the opposed axial end walls. One column may be on the axis of the vessel and/or plural columns may be equally angularly spaced about the axis.

- 5 The fuel vessel may be secured in position in the automobile or other support by external strapping, but in a preferred embodiment the or at least one of the columnar reinforcing means projects through at least one of the opposed axial end walls and is threaded exteriorly  
10 of the chamber to facilitate securement of the vessel either directly to the support or through appropriate strapping. The or at least one of the columnar reinforcing means may be hollow and open at each end to the exterior of the vessel to receive a locating bolt or  
15 stud therethrough.

- Where the internal reinforcing means does not include columnar reinforcing means which provide locating means for the vessel, such locating means may be provided by  
20 extending one or both of the opposed axial end walls of the vessel beyond the outer periphery and having the locating means extend through or from one or both of said extended opposed walls.

- 25 The outer periphery of the vessel is most preferably defined by a substantially axially extending outer wall which may be strengthened if necessary by, for example, giving it a rippled configuration or by making it externally convex.

- 30 Generally, the opposed axial end walls will be substantially flat and extend substantially parallel, but one or both may be strengthened further by, for example, being externally concave and/or rippled. A reinforcing  
35 plate may be welded or otherwise secured to one or both of the opposed axial end walls.

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In one embodiment of the fuel vessel, the outer wall is at least primarily defined by a wall member which extends into a substantially radial plane of one of the opposed axial end walls and is welded to a member primarily  
5 defining said one axial end wall at a location spaced from a corner between the axial extent of the wall member and said one axial end wall. This has the advantage of removing the weld between the outer wall member and the one axial end wall to a position remote from a corner of  
10 the vessel. Additional strengthening may be achieved by providing a member defining the other axial end wall which extends around the opposite corner to partly define the outer wall and which is welded to said wall member at a location spaced from said opposite corner.

15 Alternatively, the vessel may be defined by a shell comprising a first of the opposed axial end walls and at least part of the outer wall and a closure comprising at least part of the second of the opposed axial end walls  
20 which is welded to the shell. Advantageously, the closure also comprises a shell defining at least part of the outer wall so that the vessel is defined by two opposed shells, each including a respective one of the opposed axial end walls, which are joined along a weld  
25 formed in the outer wall. The outer wall of such a vessel may be externally convex and in one embodiment is substantially arcuate in cross-section. The weld joining the two opposed shells defining the vessel is conveniently along a diametrical plane which preferably  
30 intersects the centre of the vessel. Advantageously, the two shells are substantially identical, but, in an alternative embodiment where only one shell is provided, the shell may also define part of the second of the opposed axial end walls. The weld conveniently defines a  
35 joggle-butt joint, but may take other forms such as a lap, butt or butt with backing plate weld.



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Where the vessel is defined by the aforementioned shell and closure, a method of manufacturing same may comprise welding the reinforcing wall means to an internal surface of the closure, providing an opening in the first-  
5 mentioned shell, welding said shell to the closure, welding the reinforcing wall means to an internal surface of the shell by providing access through the opening and closing the opening.

10 Where the aforementioned vessel defined by a shell and closure also includes columnar reinforcing means the method of manufacture may further comprise securing the columnar reinforcing means to a plate adapted for closing the opening, slidably disposing the columnar reinforcing  
15 means in a corresponding aperture(s) through the closure, sliding the columnar reinforcing means through the corresponding aperture(s) to locate the plate in the opening after the reinforcing wall means has been welded to the closure and the shell, welding the plate in the  
20 opening to close the opening, and sealing the columnar reinforcing means to the closure, for example by welding.

Various embodiments of pressurized fuel vessel for use in an automobile and in accordance with the invention will  
25 now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a sectional view of a first embodiment of the pressure vessel taken on the line A-A of Figure 2;

Figure 2 is a plan view of the vessel in Figure 1;

30 Figures 3a-c are enlargements of parts of Figure 1, illustrating the welding of the various components; these figures are shown rotated through 90° compared to Figure 1 for convenience only;

Figure 4 is a cross-sectional view of a second  
35 embodiment of the pressure vessel;

Figure 5 is a sectional view of a third embodiment

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of the pressure vessel taken on the line B-B of Figure 6;

Figure 6 is a plan view of the vessel of Figure 5;

Figure 7 is a sectional view of a fourth embodiment of the pressure vessel taken on the line C-C of Figure 8;

5 Figure 8 is a plan view of the vessel of Figure 7;

Figure 9 is a scrap sectional view similar to Figure 5 but showing various modifications which may be made to the outer wall and opposed axial end walls;

10 Figure 10 is a sectional view of a fifth embodiment of the pressure vessel;

Figure 11 is a sectional view of a sixth embodiment of the pressure vessel;

Figure 12 is a cross-sectional view of a seventh embodiment of the pressure vessel; and

15 Figure 13 is a view similar to Figure 12 showing a modification to the seventh embodiment.

Several embodiments are shown in the drawings of a relatively squat substantially cylindrical pressurized fuel vessel with an internal reinforcing wall, and it is to be understood that modifications described in relation to one embodiment may be applied, as appropriate, to any other embodiment.

25 Furthermore, in view of the overall similarity of several of the embodiments, the same reference numerals will be used for convenience to describe the same or similar parts in different embodiments.

30 Referring firstly to Figures 1 to 3, the pressurized fuel vessel 10 comprises flat circular top and bottom walls 12 and 14 joined at their periphery by a cylindrical axial wall 16 welded to the top and bottom walls as shown for example in Figure 3a. Each of the walls may be formed of  
35 suitable metal such as mild or stainless steel. The vessel 70 has a squat cylindrical shape in which the

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diametrical dimension is approximately  $2\frac{1}{2}$  times the axial dimension. Adjacent the axis 18, the top and bottom walls are reinforced by four columnar steel rods 20 which extend between and through the top and bottom walls and  
5 are externally screw threaded outwardly of the interior of the vessel to facilitate location of the vessel as desired. The columnar rods 20 are equally angularly spaced on an imaginary circle centred on the axis 18 of the vessel. The columnar rods 20 are welded to the top  
10 and bottom walls 12 and 14 as shown for example in Figure 3c to seal the interior of the vessel.

In order to further reduce the minimum permissible thicknesses of the top and bottom walls 12 and 14, a  
15 substantially cylindrical wall member 22 extends between the top and bottom wall members coaxially with the axis 18 of the vessel between the columnar rods 20 and the axial wall 16. The wall member 22 is welded to the top and bottom walls 12 and 14 for example as shown in Figure  
20 3c which shows the edge 24 of the wall member curved radially inwardly. For maximum advantage, the wall member 22 is disposed midway between the imaginary circle on which the rods 20 are located and the axial wall 16. The wall member 22 may be formed of the same material as  
25 the axial wall 16 and has an opening 26 therethrough to permit the contents of the vessel to flow between portions of the vessel respectively radially inwardly and radially outwardly of the wall member 22. The wall member 22 may be formed in several parts to define  
30 several openings 26 between the several parts. It will be appreciated that other forms of opening may be provided through the wall member 22.

The vessel 10 may be formed by tack welding the wall  
35 member 22 between the top and bottom walls 12 and 14 to locate same, and then continuously welding same to the

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top and bottom walls as shown in Figure 3c through the open outer periphery of the vessel. The axial wall 16 is then welded to the top and bottom walls as shown in Figure 3a. The axial wall 16 may either be slid over one  
5 of the top and bottom walls 12 and 14, or curved from flat plate as it is welded into place, or it may be split axially with the split being welded closed once the axial wall has been welded in position. The columnar rods 20 may then be welded in position as shown in Figure 3b to  
10 seal the vessel.

If it is desired to have plural concentric wall members 86 disposed within the vessel, for example if the vessel has an even greater diametrical to axial dimension ratio  
15 these may be formed in arcuate parts between which the openings to provide fluid flow passage are provided, as shown for example in Figures 4 to 8, with the wall members being welded to the top and bottom walls consecutively from the innermost.

20 A multivalve assembly (not shown) will usually be provided in a single reinforced opening (not shown in Figures 1 and 2) in the outer wall 16 of the vessel, to control fuel flow to and from the vessel and to measure  
25 the volume of fuel in the vessel.

Instead of having the locating means forming part of the columnar rods 20, the top and/or bottom walls 12 and 14 may be extended radially beyond the axial wall 16, for  
30 example as shown in Figure 8, and appropriate stud or other fastening means may extend from same. Under these circumstances, or in other circumstances, the columnar rods 20 may be omitted altogether for example as shown in Figure 10 or may, if desired, be replaced by a further  
35 wall member.

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Referring to Figure 4, the vessel 30 is identical to the vessel 10 of Figures 1 and 2 except that the four columnar rods 20 are replaced by a central rod 32 on the axis 18 and a cylindrical reinforcing wall 34 which is welded between the inner surfaces of the top and bottom walls 12 and 14 on the imaginary circle of the rods 20 in Figures 1 and 2. Thus, the cylindrical walls 22 and 34 are equally spaced between the coaxial rod 32 and the axial wall 16. The rod 32 may be secured to the top and bottom walls 12 and 14 as described with reference to Figure 3b, but may not be threaded. Instead, four locating rods 36 identical to the rods 20 in Figures 1 and 2 are shown equally angularly spaced about the axis 18 immediately radially outwardly of the cylindrical reinforcing wall 22.

Each of the cylindrical walls 22 and 34 is shown formed in two halves with respective fuel flow openings 26 therebetween. A reinforced opening 38 is shown in the outer wall 16 to receive a multivalve assembly.

Referring now to Figures 5 and 6, a modified version 30' of the vessel 30 of Figure 4 is shown in which the sole difference is the omission of the locating rods 36. The vessel 30' could be located by threading the axial rod 32 or, for example, by means of strapping (not shown) which would envelop the vessel.

In Figures 7 and 8 a modified version 30'' of the vessel 30' of Figures 5 and 6 is shown in which the top wall 12 has four radially projecting lugs 40 which are adapted to be used to secure the vessel in place. Each lug 40 has an axial opening 42 therethrough in which a locating hook or bolt (not shown) may be secured.

An additional reinforcing of the bottom wall 14 is shown

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by way of example in Figure 7 in which the radially inner portion thereof, that is radially inwardly of the outer cylindrical reinforcing wall 22, is externally concave. In addition to reinforcing the bottom wall 14 somewhat, 5 the concavity may assist to locate the vessel 30'' in the well in a boot of a vehicle where the well has a central inwards projection or rib as is quite common. The degree of concavity may be varied prior to manufacture according to the size of any such rib or projection. It will be 10 readily understood that the additional reinforcing of the bottom wall 14 may be achieved without the locating lugs 40 illustrated in Figure 8.

Referring now to Figure 9, further modifications or 15 variations to the vessel 30' and 30'' are illustrated, all for the purposes of reinforcing the top and/or bottom walls and/or the axial wall, although such modifications or variations may be applied to other vessels described herein, as appropriate.

20 Referring firstly to the left hand portion of Figure 9, there is shown a modification which applies to the vessel as a whole. In the embodiments described heretofore, the junction between the axial wall and the top and bottom 25 walls, respectively, is sharp and may give rise to a degree of weakness. In the modification to the left hand side of Figure 9, the bottom wall 14' is extended upwardly about a rounded corner 44 so that the member 46 defining the bottom wall 14' is shell like. The outer 30 wall member 48 is welded to the bottom wall member 46 remote from the corner 44 to define a toggle joint 50. The top wall member 52 is of reduced diameter compared to the overall top wall and the outer wall member 48 projects radially inwardly at its upper end about a 35 further rounded corner 54 to define an inwardly directed flange 56 which is welded to the top wall member 52 at a

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toggle joint 58. The vessel is manufactured as previously described in that the or each reinforcing wall member 34 and 22 is welded to the top and bottom wall members 52 and 46 through the outer periphery of the vessel, following which the outer wall member 48 is welded in place.

Alternative modifications are illustrated at the right hand end of Figure 9 where both the top wall 12'' and the axial wall 16' are given an annular rippled effect for reinforcing purposes. The or each reinforcing wall 22 and 34 is welded to the top wall 12'' at a land 60 between externally convex ripples. The land 60 is illustrated in Figure 9 as having minimal radial dimension, but may be extended radially as desired. Likewise, the axial wall 16' is welded to the top wall 12'' at a flat portion 62. Of course, the bottom wall 14 may also be rippled or reinforced in some other manner.

In a further modification to the right hand side of Figure 9 (shown in dashed lines) the axial wall 16'' may be given an externally convex configuration.

Referring now to Figure 10, a modified version 10' of the vessel 10 of Figures 1 and 2 is shown in which the columnar rods 20 are replaced by alternatively reinforced top and bottom walls 12 and 14. Both top and bottom walls 12 and 14 are shown recessed radially inwardly of the cylindrical reinforcing wall 22 with, in contrast to the concavity in the bottom wall 14 of vessel 30' (Figure 7), the recesses 64 being substantially flat. As indicated with reference to Figure 7, the recess 64 in the bottom wall 14 may accommodate a rib or other projection in the bottom of the spare wheel well of a vehicle. In contrast, the recess 64 in the top wall 12 is itself reinforced by a circular plate 66 welded about

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its periphery to the top wall 12. Clearly, the recesses 64 may be reinforced in some other way, for example by means of the rippling illustrated in Figure 9 or by some other rib formation.

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Referring now to Figure 11, there is shown a further embodiment of pressurized fuel vessel 70 in accordance with the invention. The vessel 70 is defined by two opposed shells 72 and 74, the former defining the top wall 76 and part of the axial wall 78, the latter  
10 defining the bottom wall 80 and a further part of the axial wall 78. Both shelves are formed by stamping or pressing, for example, mild or stainless steel and each defines approximately one half of the axial wall 78 so  
15 that the welded toggle joint 82 is on a diametrical plane intersecting the axial mid-point of the vessel 70. Alternatively, the join could be axially offset towards one or other of the top and bottom walls 76 and 80 or, indeed, be in one of said top and bottom walls in which  
20 case the corresponding shell would be replaced by a substantially flat plate which could be reinforced by any one or more of the aforescribed means.

A problem with this construction is that it is not  
25 possible to weld the cylindrical reinforcing wall 84 to the top and bottom walls 76 and 80 from the outer periphery. In order to overcome this, an opening 86 is provided in the centre of one of the top and bottom walls (the bottom wall 80 in Figure 11), through which access  
30 may be had to weld the reinforcing wall 84 in place. The reinforcing wall 84 may be welded to one of the shells 72 and 74, usually the shell 72, before the shells are fitted together. Once the reinforcing wall 84 has been welded in place, a plate 88 is welded to the shell 74 to  
35 close the opening 86.



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As illustrated in Figure 11, the vessel 70 has columnar reinforcing rods 90 which are much as described with reference to the rods 20 described with reference to Figures 1 and 2 except that the rods 90 are hollow to receive locating bolts therethrough. In order to manufacture the vessel 70 with the reinforcing rods 90, the rods may be welded to the plate 88 and slid through corresponding apertures 92 in the shell 72 to seat the plate 88 in the opening 86. Once the plate 88 has been welded to the shell 74, the rods 90 may be welded in the apertures 92 to seal the apertures.

Referring now to Figure 12, a modified version 100 of the vessel 30' of Figures 5 and 6 is shown in which the sole difference is that the two cylindrical reinforcing walls 22 and 34 of the vessel 30' are replaced by a single spiral reinforcing wall 102. The spiral reinforcing wall may be made of suitable mild or stainless steel, for example, and extends through approximately 720° from its radially inner end which is spaced from the axial reinforcing rod 104 to its radially outer end which abuts the axial wall 106. It will be clear that a plurality of spiral wall members may be adopted if desired or, for example, that the radially inner cylindrical reinforcing wall 34 may be retained with the spiral reinforcing wall 102 extending radially outwardly relative therefrom.

In the modification in Figure 13, the spiral wall member 102 is integral and co-extensive with the outer wall 106 so that the spiral wall member is effectively continued through a further 360° to define the outer wall and to be welded to itself at 108.

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Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention  
5 includes all such variations and modifications which fall within its spirit and scope.

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## CLAIMS

1. A pressurized fuel vessel for automotive or other use having opposed axial end walls connected at or adjacent an outer periphery to define an enclosed chamber, said vessel being of greater diametrical dimension (as herein defined) than axial dimension, and wherein internal reinforcing means extends between the opposed axial end walls, said internal reinforcing means comprising at least one reinforcing wall means which extends at least substantially about an axis of the vessel intermediate the axis and the outer periphery, said at least one reinforcing wall means being adapted to permit pressurized fuel to flow between portions of the chamber respectively disposed radially inwardly and radially outwardly thereof.
2. A vessel according to Claim 1 wherein said at least one reinforcing wall means is substantially annular.
3. A vessel according to Claim 2 wherein a plurality of substantially annular reinforcing wall means are substantially equally radially spaced between the axis and the outer periphery.
4. A vessel according to Claim 2 wherein the annulus of said at least one substantially annular reinforcing wall means is discontinuous to permit said pressurized fuel flow.
5. A vessel according to Claim 1 wherein said reinforcing wall means has a spiral configuration.
6. A vessel according to Claim 1 wherein said at least one reinforcing wall means is welded to the axially inner surface of each of said opposed axial end walls.

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7. A vessel according to Claim 1 wherein at least one opening is provided between the at least one reinforcing wall means and one of the axial end walls to permit said pressurized fuel flow.
8. A vessel according to Claim 1 which includes additional internal reinforcing means to said at least one reinforcing wall means.
9. A vessel according to Claim 8 wherein said additional internal reinforcing means comprises columnar reinforcing means.
10. A vessel according to Claim 9 wherein the or at least one of the columnar reinforcing means projects through at least one of the opposed axial end walls and is threaded exteriorly of the chamber.
11. A vessel according to Claim 9 wherein the or at least one of the columnar reinforcing means is hollow and is open at each end to the exterior of the vessel.
12. A vessel according to Claim 1 wherein the outer periphery is defined by a substantially axially extending outer wall.
13. A vessel according to Claim 12 wherein the outer wall is rippled and/or externally convex.
14. A vessel according to Claim 12 wherein said outer wall is at least primarily defined by a wall member which extends into a substantially radial plane of one of the opposed axial end walls and is welded to a member primarily defining said one axial end wall at a location spaced from a corner between the axial extent of the wall member and said one axial end wall.

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15. A vessel according to Claim 14 wherein a member defining the other axial end wall extends therefrom around a corner to partly define the outer wall and is welded to said wall member at a location spaced from said corner.

16. A vessel according to Claim 12 which is defined by a shell comprising a first of the opposed axial end walls and at least part of the outer wall and a closure comprising at least part of the second of the opposed axial end walls which is welded to the shell.

17. A vessel according to Claim 16 wherein the closure also comprises a shell defining at least part of the outer wall.

18. A vessel according to Claim 12 wherein said at least one reinforcing wall means has a spiral configuration and the outer wall is integral with said at least one reinforcing wall means.

19. A vessel according to Claim 1 wherein either or both of the opposed axial end walls is externally concave and/or rippled.

20. A vessel according to Claim 1 which has a substantially circular axial cross-section.

21. A method of manufacturing a pressurized fuel vessel according to Claim 1 which has an outer wall member at least partly defining the outer periphery which comprises welding said at least one reinforcing wall means to opposed wall members at least partly defining the opposed axial end walls from a radially outwards location through the open outer periphery of the vessel and welding the outer wall member to said opposed wall members.

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22. A method according to Claim 21 when the at least one reinforcing wall means has a spiral configuration and is integral with the outer wall member and wherein the method comprises continuing to weld said at least one reinforcing wall means of spiral configuration to said opposed wall members at said outer periphery to define said outer wall member.

23. A method of manufacturing a pressurized fuel vessel according to Claim 16 which comprises welding the reinforcing wall means to an internal surface of the closure, providing an opening in the shell, welding said shell to the closure, welding the reinforcing wall means to an internal surface of the shell by providing access through the opening and closing the opening.

24. A method according to Claim 23 wherein the closure also comprises a shell defining at least part of the outer wall.

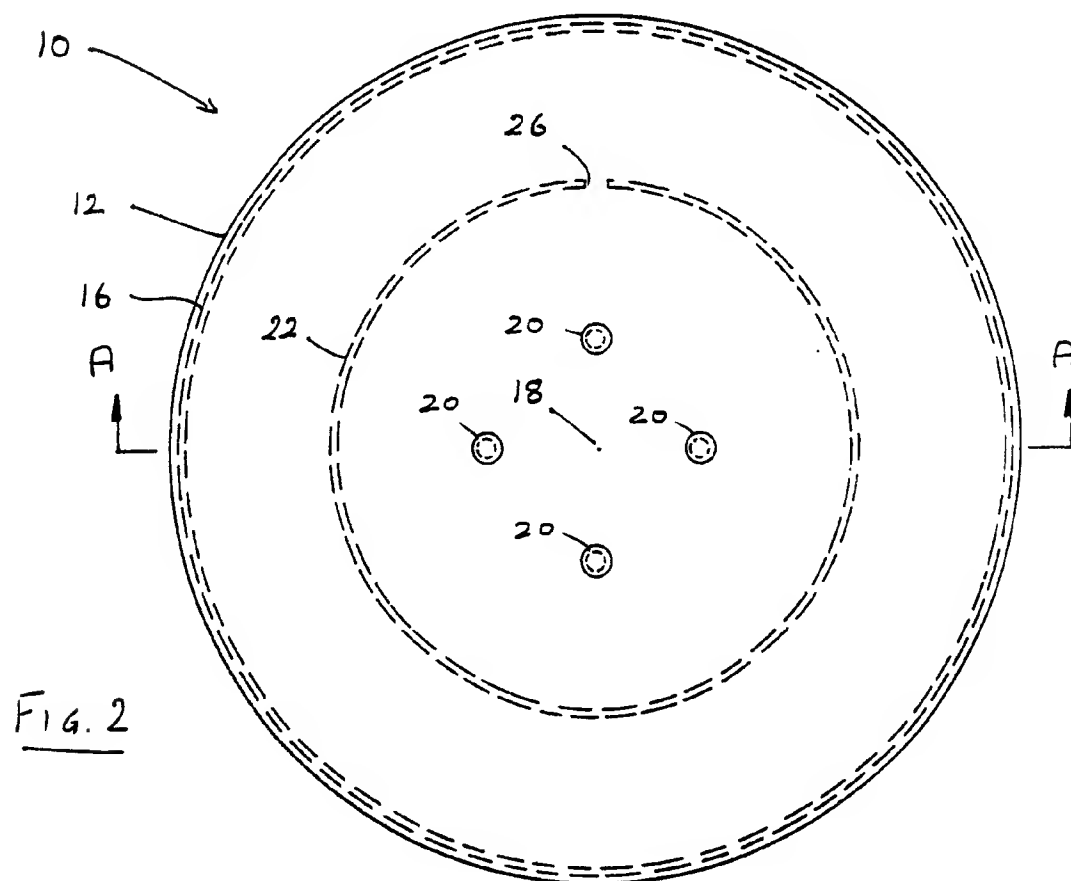
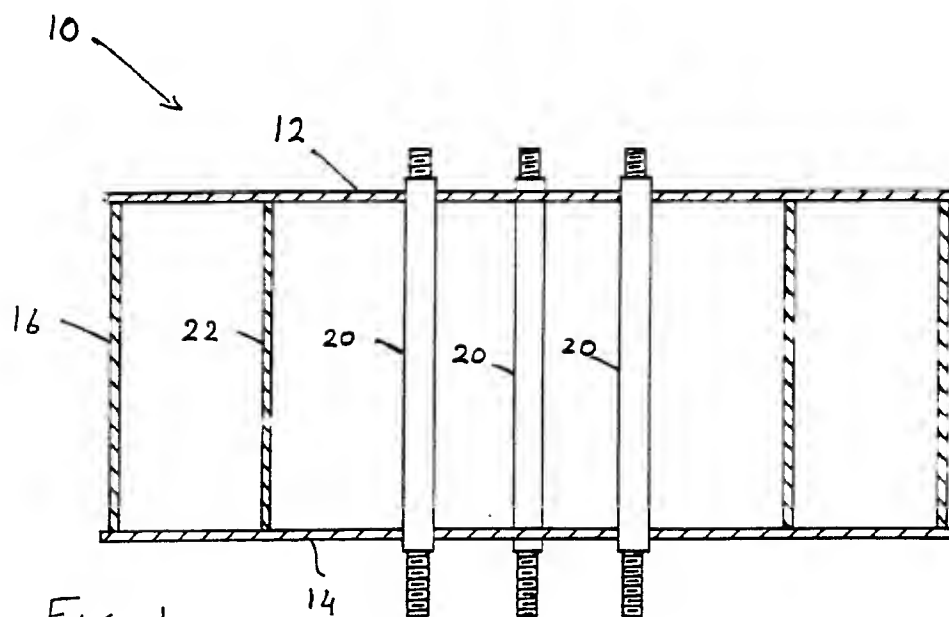
25. A method according to Claim 23 wherein the vessel also includes columnar reinforcing means, which method further comprises securing the columnar reinforcing means to a plate adapted for closing the opening, slidably disposing the columnar reinforcing means in a corresponding aperture(s) through the closure, sliding the columnar reinforcing means through the corresponding aperture(s) to locate the plate in the opening after the reinforcing wall means has been welded to the closure and the shell, welding the plate in the opening to close the opening, and sealing the columnar reinforcing means to the closure.

## AMENDED CLAIMS

[received by the International Bureau on 28 January 1992 (28.01.92);  
original claim 1 amended; other claims unchanged (1 page)]

1. (amended) A pressurized fuel vessel for automotive  
or other use having opposed axial end walls connected at  
5 or adjacent an outer periphery to define an enclosed  
chamber, said vessel being of greater diametrical  
dimension (as herein defined) than axial dimension, and  
wherein internal reinforcing means extends between the  
opposed axial end walls, said internal reinforcing means  
10 comprising at least one reinforcing wall means which  
extends within the chamber at least substantially about  
an axis of the vessel intermediate the axis and the outer  
periphery, said at least one reinforcing wall means being  
adapted to permit pressurized fuel to flow between  
15 portions of the chamber respectively disposed radially  
inwardly and radially outwardly thereof.
2. A vessel according to Claim 1 wherein said at least  
one reinforcing wall means is substantially annular.  
20
3. A vessel according to Claim 2 wherein a plurality of  
substantially annular reinforcing wall means are  
substantially equally radially spaced between the axis  
and the outer periphery.  
25
4. A vessel according to Claim 2 wherein the annulus of  
said at least one substantially annular reinforcing wall  
means is discontinuous to permit said pressurized fuel  
flow.  
30
5. A vessel according to Claim 1 wherein said  
reinforcing wall means has a spiral configuration.
6. A vessel according to Claim 1 wherein said at least  
35 one reinforcing wall means is welded to the axially inner  
surface of each of said opposed axial end walls.

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FIG. 3a

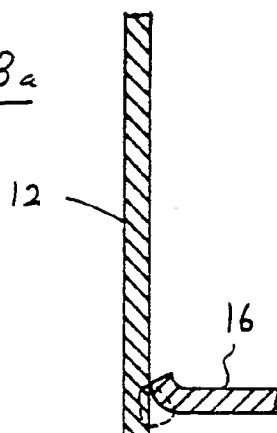


FIG. 3b

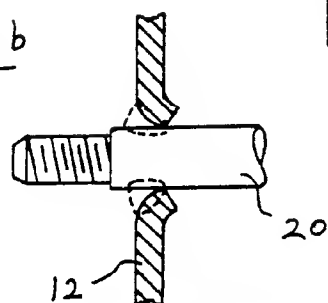


FIG. 3c

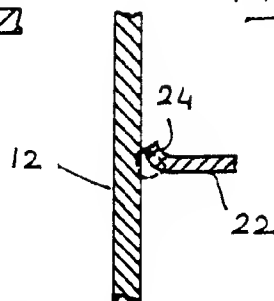
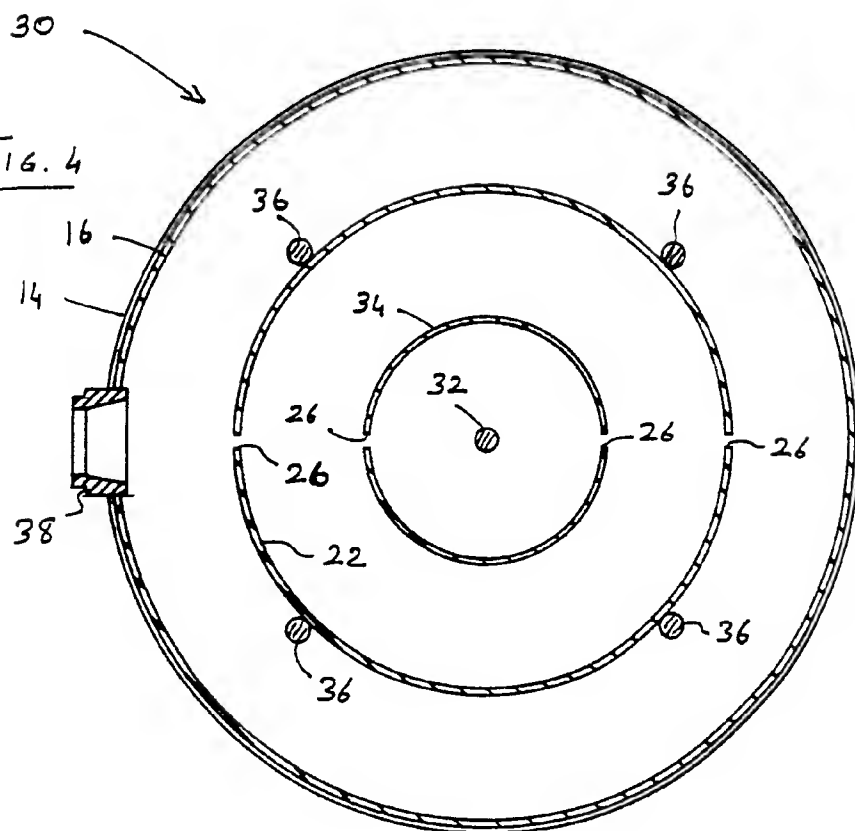


FIG. 4



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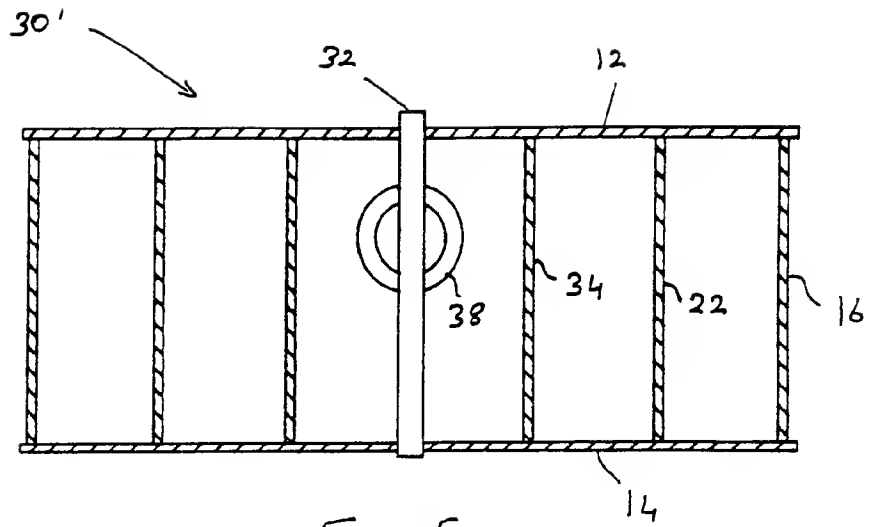
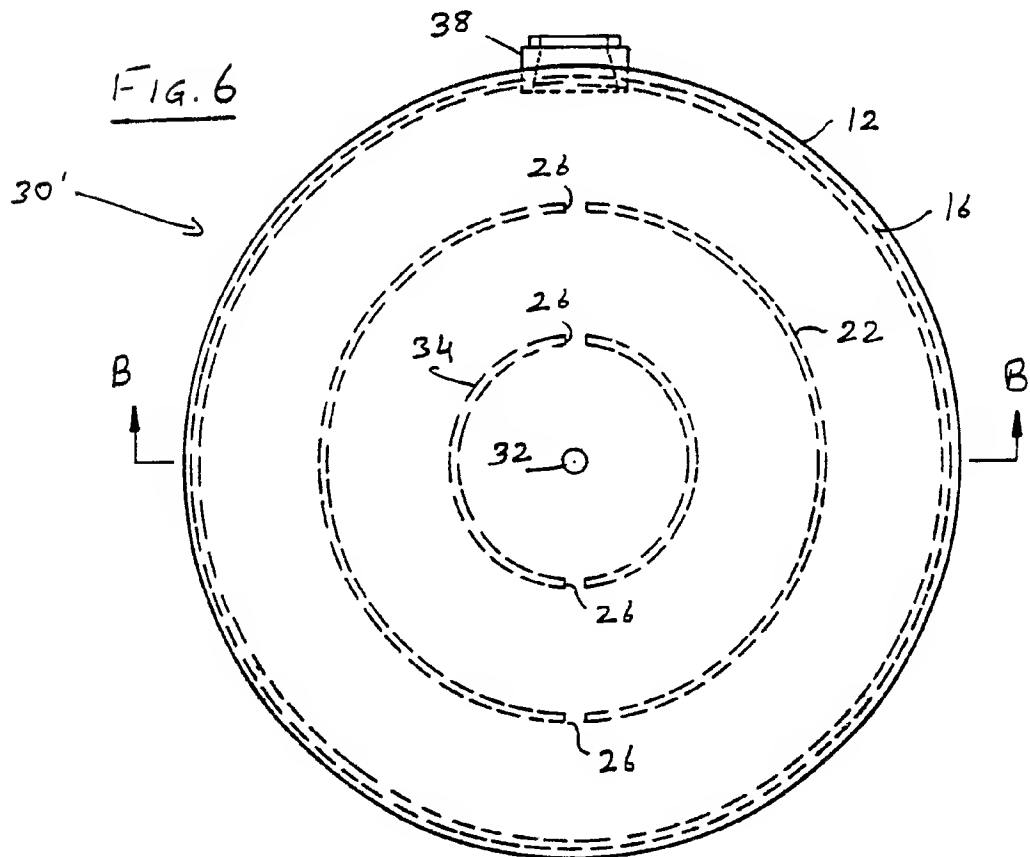
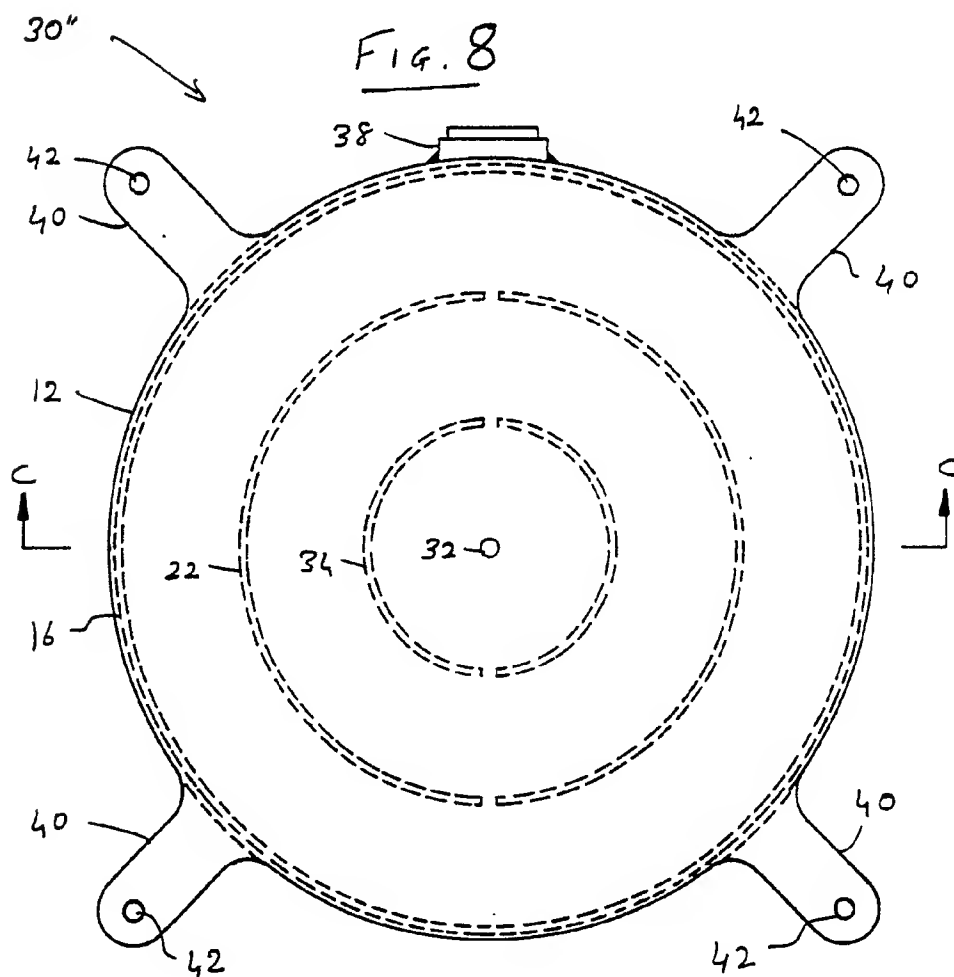
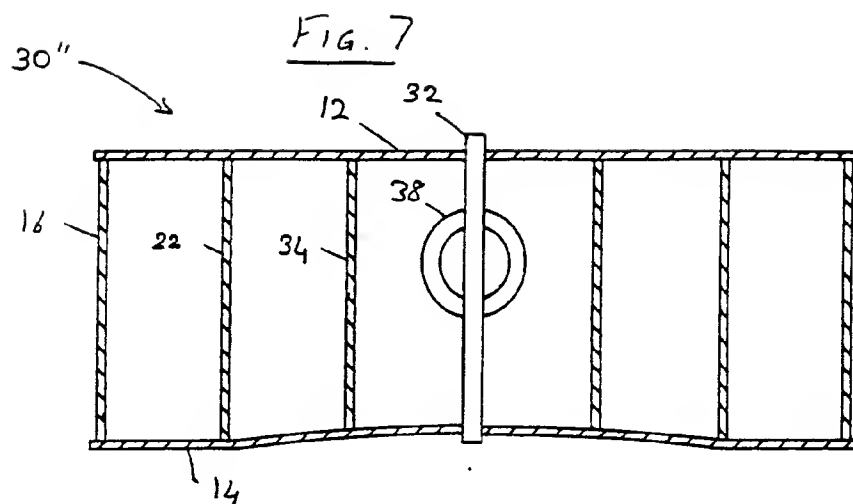


Fig. 5

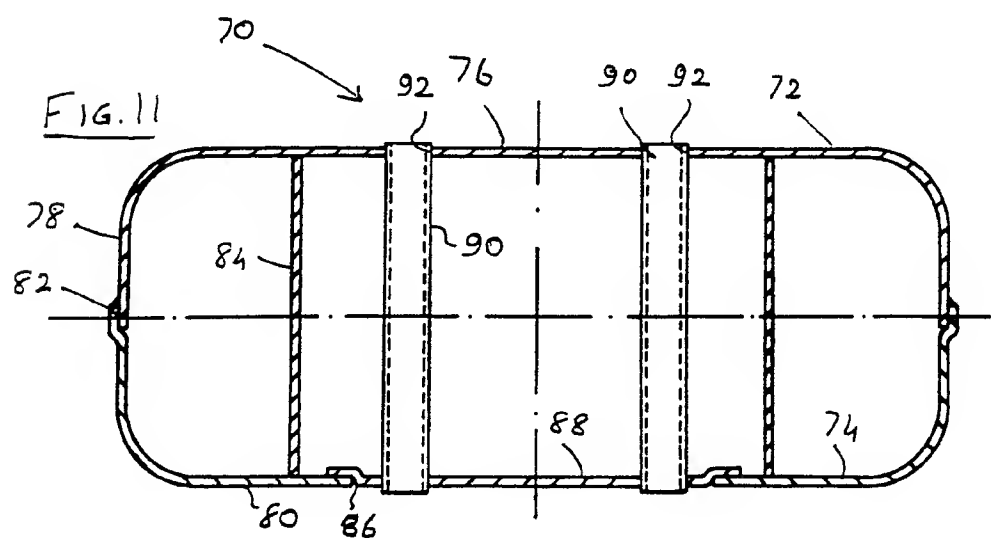
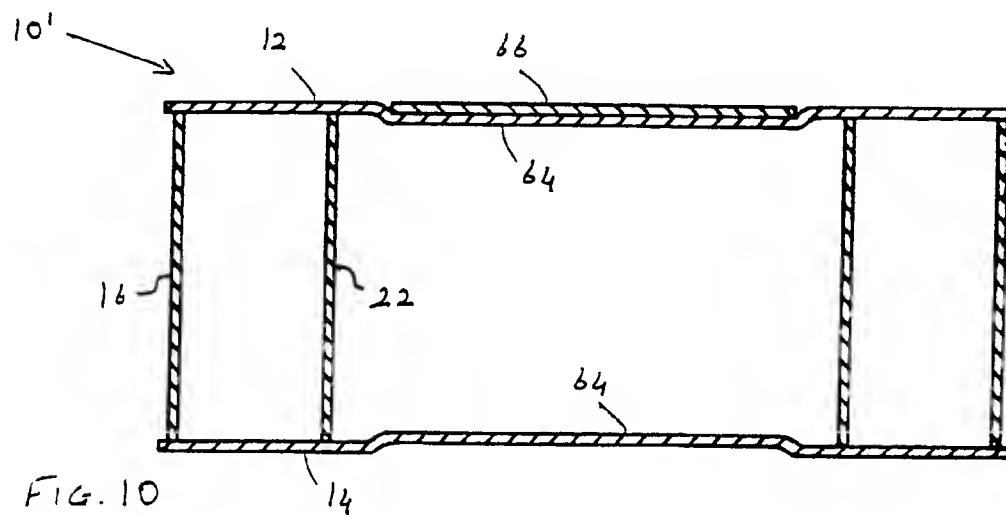
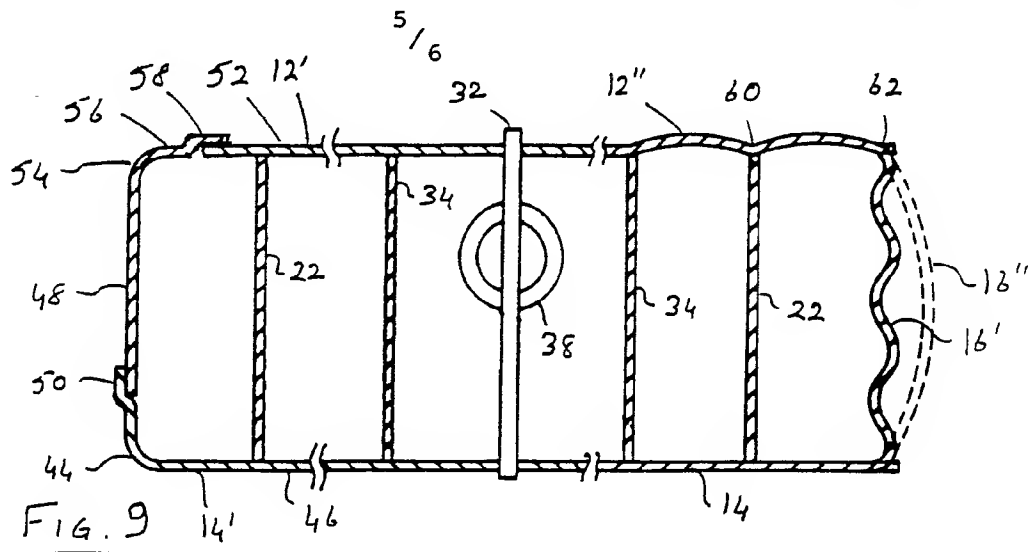


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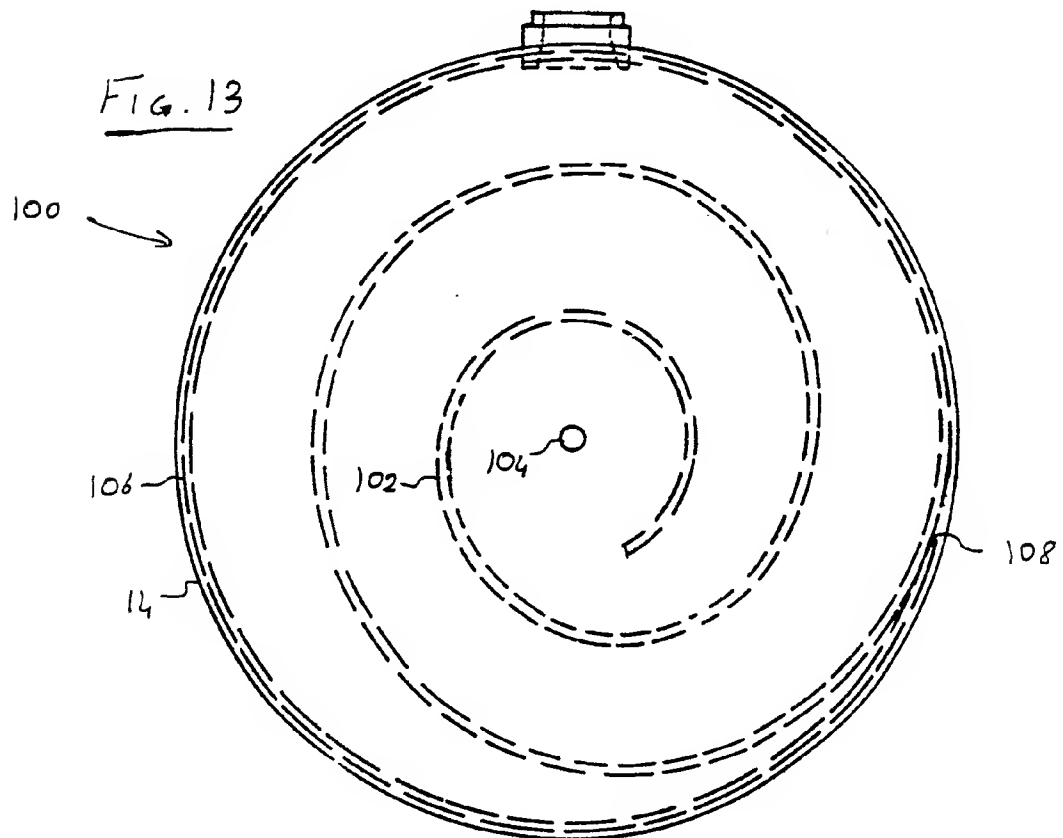
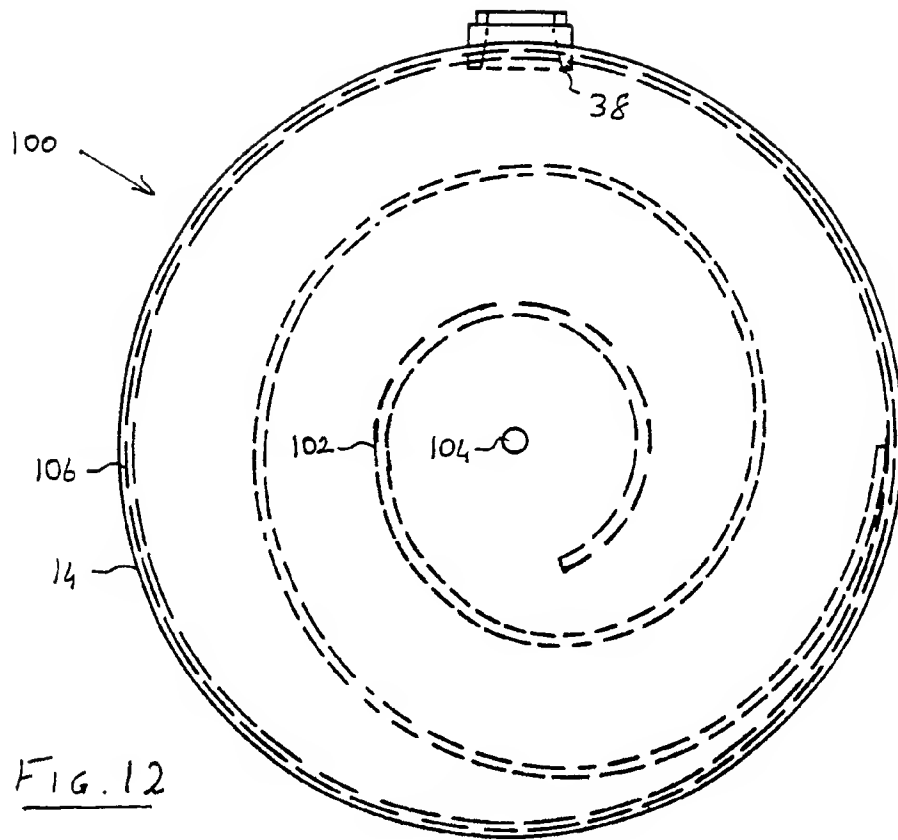


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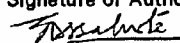
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## INTERNATIONAL SEARCH REPORT

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent classification (IPC) or to both National Classification and IPC Int. Cl. <sup>8</sup> F17C 1/08		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC	F17C 1/08	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched <sup>8</sup>		
AU: IPC as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>*</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate of the relevant passages <sup>12</sup>	Relevant to Claim No <sup>13</sup>
X	GB,A, 499366 (T.M. CONNELLY) 23 January 1939 (23.01.39)	(1,8,9,11)
A	US,A, 2920784 (BOARDMAN, H.C.) 12 January 1960 (12.01.60)	(1)
A	GB,A, 595135 (CHICAGO BRIDGE & IRON CO.) 27 November 1947 (27.11.47)	(1)
<p><sup>*</sup> Special categories of cited documents : <sup>10</sup></p> <p>"A" Document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" Later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search 27 November 1991 (27.11.91)		Date of Mailing of this International Search Report 13 January 92
International Searching Authority  <b>AUSTRALIAN PATENT OFFICE</b>		Signature of Authorized Officer  G.S. SAHOTA